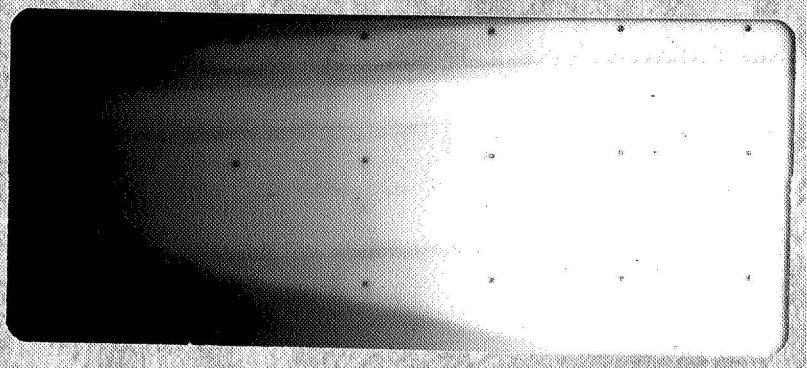

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DESTINATION--VENUS

Communiques and Papers Taken From the Soviet Press, February 14-19, 1961

Report No. 1

Compiled and translated by

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JET PROPULSION LABORATORY
California Institute of Technology
Pasadena, California
March 3, 1961

DESTINATION--VENUS

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Report No. 1

RADIO MOSCOW (9.775 mc), 1405 PST, February 12, 1961

Persistent experiments have finally resulted in a successful launching of a deep-cosmic probe from an orbiting satellite. On two previous occasions, the Soviet Union has experimented in placing heavy satellites in parking orbits.

On February 11, 1961, the Soviet Union launched a heavy satellite into a 625 km parking orbit. After the satellite was stabilized and it achieved the necessary coordinates, a signal was given from a ground station. In response to that signal, an automatic interplanetary observatory was launched from the satellite toward the planet Venus; the space probe, which is guided by telemetry from the ground, achieved the necessary escape velocity.

The weight of the interplanetary station is 643.5 kg. The station carries a pennant with the Soviet emblem which will be deposited on the surface of Venus, if the experiment is successful. The station is heavily equipped with transmitters and other telemetry equipment. Transmissions are made on six frequencies, two of which are 922.8 mc and 183.6 mc. The signals are loud and clear. Tracking stations around the world have been alerted, and they are participating in tracking the interplanetary station.

As of 1200 Moscow time, February 12, 1961, the coordinates of the interplanetary station were as follows: 86° 40'E longitude and 6° 4'N latitude. The distance of the station from the Earth at that time was 126, 300 km.

The satellite, which carried the interplanetary station to its parking orbit, was launched with the help of a multistage rocket.

The interplanetary station should reach Venus in the latter part of May, 1961. The main purpose of this experiment is to check possibilities of placing rockets on an interplanetary trajectory; checking super-long-range radio communications and cosmic-station guidance; and ascertaining with greater exactitude the scope of the solar system and conducting similar types of physical research in outer space.

RADIO MOSCOW (9.800 mc), 2100 PST, February 13, 1961

The interplanetary station is traveling along a perfect trajectory for an orbit around Venus.

At 900 GMT, the station was traveling at a velocity of 14, 000 ft/sec; the temperature at that time was +68° F.

The station is sending back information on the following:

(1) Cosmic rays

(2) Magnetic field

(3) Micrometeorite impact

(4) Interplanetary matter

(5) Temperature inside the station

(6) A device for distance measurements

The power supply consists of chemical batteries which are charged periodically by solar batteries. The interplanetary station will be interrogated every 5 days.

At 900 GMT the station reached a distance of 306, 000 miles from the surface of the Earth; the stations coordinates were 53'N latitude and 88° 2'E longitude. The station was in the vicinity of the constellation of Pisces.

IZVESTIA, February 14, 1961
TASS Communique

In accordance with the program for the investigation of outer space, the Soviet Union has placed in orbit a heavy artificial Earth satellite on February 12, 1961. The satellite was placed in orbit with the help of a multistage rocket.

During that same day a guided rocket which was launched from aboard the satellite injected an automatic interplanetary station on a trajectory toward the planet Venus.

The automatic interplanetary station will reach the area of the planet Venus in the second half of May, 1961.

The principal tasks of this launching are to check the methods for the injection of cosmic objects into an interplanetary path; to check long-range radio communication and guidance of the cosmic station; the perfection of measurements of the solar system; and the conduction of a number of physical investigations in space.

The instruments which are installed aboard the interplanetary station are operating in a normal manner. The weight of the automatic interplanetary station is 643. 5 kg.

Radio transmissions from aboard the interplanetary station are made on a frequency of 922. 8 mc by command from Earth.

The automatic interplanetary station carries in its nose a pennant with the image of the State Emblem of the USSR.

Special tracking centers are following the progress of the interplanetary station.

According to obtained data, the movement of the automatic interplanetary station is traversing an orbit which is very close to the calculated.

At 1200 Moscow time, February 12, 1961, the interplanetary station was at a distance of 126,300 km from the surface of the Earth and above a point on the Earth's surface having geographical coordinates of 86° 40'E longitude and 6° 4'N latitude.

The successful launching of a cosmic rocket toward the planet Venus actually paves the way for interplanetary flights to planets of the solar system.

PRAVDA, February 14, 1961
TASS Communique

The automatic interplanetary station continues its flight along the desired route.

At 1200 Moscow time, February 13, 1961, the station has departed from Earth to a distance of 488,900 km and passed over a point with the geographical coordinates of 0° 53'N latitude and 88° 2'E longitude. The station was located in a region of the firmament (Fig. 1) which is adjacent to the constellations of Cetus and Pisces, in the center of a triangle formed by the constellations of β Aries, α Pegasus, and β Cetus.

Trajectory measurements which were obtained have shown that the heavy artificial Earth satellite was injected with great preciseness into a precalculated orbit around the Earth. The cosmic rocket which was launched from the satellite has secured an accurate injection of the automatic interplanetary station into a flight trajectory toward the planet Venus.

The flight speed of the interplanetary station in the beginning of the trajectory toward Venus has exceeded the magnitude of the second cosmic velocity. During its subsequent flight, the velocity of the interplanetary station began to decrease due to the influence of the Earth's gravitational pull. At noon on February 13, the speed of the interplanetary station's departure from the Earth was 4,050 meters/sec. After a few days of flight, the automatic interplanetary station will leave the boundaries of the so-called "sphere of the Earth's gravitation," having a velocity somewhat less than 4 km/sec.

Scientific instrumentation which was installed aboard the automatic interplanetary station was designed for the investigation of cosmic rays, magnetic fields, interplanetary matter, and the registration of collisions with micrometeorites.

For the purpose of securing operational conditions for the instruments, the temperature aboard the interplanetary station is maintained within predetermined limits with the help of a temperature regulating system.

Aboard the station is installed an electronic technical system which is designed for solving the following problems:

(1) The measurement of flight parameters of the station in relation to the Earth.

(2) Transmission to Earth of measurement results which are being conducted aboard by the scientific instrumentation.

(3) Transmission to Earth of information on the operational mode of all systems and installations aboard the spaceship.

During the periods of interrogation the instrumentation is powered by chemical power-sources which are continuously charged during the flight by energy from solar

batteries. The assurance of continuous illumination by the Sun of the solar batteries (in order to obtain the maximum energy from them) is conducted with a solar orientation system.

After the launching of the interplanetary station, two communication sessions took place. During these sessions, trajectory measurements were conducted, and a large volume of radio telemetry information was received.

According to data which was obtained at the computation center, all systems aboard the automatic interplanetary station have functioned in accordance with the program. During the last interrogation, the temperature aboard the station was +20°C. The solar batteries were correctly oriented in relation to the Sun and they delivered the necessary current. Processing of the obtained telemetry information continues.

Communication with the automatic interplanetary station will be conducted once every 5 days.

Communiques on the progress of the station and the measurement results will be published once every week.

THE DISTANT PLANET VENUS

by

Professor I. Shklovsky

Izvestia, February 14, 1961

"On the distant planet Venus,
The Sun is more flaming and golden.
On Venus, on Venus,
The trees must have gray leaves ..."

These verses were written 40 years ago by the Russian poet, Gumilev. The gray leaves of Gumilev are actually a poetical metaphore. Gumilev was a fine poet; however, he could not foresee the birth of a new science--astrobotanics. In accordance with the founder of this science, G. A. Tikhov, "gray leaves" should be present in Martian plants while these are getting accustomed during their long evolution to the harsh conditions of that planet. On Venus, to the contrary, because "the Sun is more flaming and golden," the leaves of trees, according to Tikhov, should be of an orange or even red coloring.

At present even science-fiction writers will have to give up their dreams about the breath-taking landscape of our cosmic neighbor. Observations during the past two years have shattered all our illusions in regard to the beautiful flora and fauna of Venus.

What has happened in science?

It is a well-known fact that the planet Venus is wrapped in a thick layer of clouds. The clouds are so dense that the surface of the planet cannot be seen at all. This is the reason why astronomers have known almost nothing about the physical conditions which prevail on the surface of Venus. The period of rotation around its axis

is still unknown. We have sufficient knowledge only about the mass of the planet, and dimensions and characteristics of its movement around the Sun (mean distance from the Sun and its orbital period).

Only the upper most layers of the Venus atmosphere (which were discovered exactly 200 years ago by the great Lomonosov) could have been studied with astrophysical methods. The chemical contents of the "peak" of the Venus atmosphere proved to differ strongly from the Earth's atmosphere. The largest component in the Venus atmosphere seems to be carbon dioxide. Several years ago, the Soviet astronomer Kozyrev observed the illumination of the night sky of Venus. This illumination proved to be quite bright. The spectroscopic method which was applied by Kozyrev made it possible for him to discover bright belts in that illumination, obviously being caused by the molecules of nitrogen. Thus it was proven that in the atmosphere of Venus there is nitrogen. This is quite natural. As is known in the atmosphere of the Earth, nitrogen has a secondary origin. That means that nitrogen was not present in our atmosphere from the beginning, but it was gradually "vaporized" from the hard crust. The same process obviously took place also on the planet Venus.

Only quite recently weak belts of water vapor were discovered in the spectrum of the Venus atmosphere. It is quite clear that the discovery of water vapors in the upper layers of the Venus atmosphere are of utmost importance.

All attempts to discover oxygen in the atmosphere of Venus were unsuccessful. It is possible to make a conclusion from this fact: that if oxygen exists in the atmosphere of Venus its amount must be a thousand times less than in the atmosphere of the Earth.

To the afore mentioned skimpy list of information about Venus, some data should be added in regard to temperature measurements of the cloud layer which is visible from the Earth. This in detail concludes our knowledge of the planet Venus up till now.

An essential change took place about two years ago, when to the aid of optical astronomy came radio astronomy. With the help of large radio telescopes and very sensitive receivers, Soviet and American radio astronomers succeeded in measuring the flux of radio emission from Venus at wavelengths within the ranges of 8 mm, 3 and 10 cm. Soviet observations were conducted by A. V. Kuzmin and A. E. Salomonovich with a 22 meter radio telescope of the Physics Institute of the Academy of Sciences,USSR.

A very valuable property of radio waves is the fact that they are capable of passing freely through dense clouds. Consequently, the source of radio emission of Venus is its surface, and not the cloud layer.

As is well known, all heated bodies emit a broad spectrum of electromagnetic waves including radio waves. Therefore, by knowing the flux of radio emission from Venus, and also the distance to that planet and its dimensions, it is possible, with the help of simple physical formulas to determine the temperature of the radiating surface. The results were remarkable. According to observations on the wavelengths of 3 and 10 cm, the temperature in certain regions of the Venus surface proved to be about +300°C. Soviet observations at a wavelength of 8 mm gave a somewhat lower value for the temperature, which obviously can be explained by the fact that the radio waves with the 8 mm length are partially absorbed by the atmosphere of Venus.

We will also mention that this temperature is an average between the day and night values, since the illuminated part of the planet is visible in the form of a bright narrow sickle (Fig. 2). Kuzmin and Salomonovich have found a systematic increase of the average temperature as the illuminated part of the planet changes due to the orbital rotations of Venus and the Earth. There is, therefore, a basis to assume that during the daytime the temperature on Venus is even higher.

What is the reason for such a high temperature on the surface of Venus? Of course the full theory of this phenomena is as yet not worked out since very little time has passed from the moment when the above described observations began.

It is a well known fact why under the glass of greenhouses fruits and plants can grow in the winter time. The solar rays freely penetrate through the glass and heat up the internal surface. The heated surface emits invisible infrared rays which are trapped by the glass. Infrared heat rays remain in the greenhouse and maintain there a warm temperature. Exactly the same process takes place on Earth. The role of the glass is played by our atmosphere. The atmosphere of Venus represents with itself a more complete greenhouse than the Earth; therefore, the temperature of the surface of the planet is very high in spite of the fact that at the summits of the cloud layer prevails a -40° C frost.

On the basis of all available radio astronomical and optical observations, we are now capable of constructing a very preliminary model of the atmosphere of Venus. First of all we must answer the question: which molecules in the Venus atmosphere cause the "greenhouse effect". Obviously these can be only molecules which absorb very strongly over the entire infrared part of the spectrum. It seems that only molecules of water vapor might give such an absorption. For this purpose, not too many

molecules are necessary--only several grams above each square centimeter of the planet's surface. This exceeds only by several times the average content of water vapor in the Earth's atmosphere. The basic part of the Venus atmosphere below the cloud cover should consist of carbon dioxide as was shown by calculations. The atmospheric pressure on the surface of Venus is approximately five times larger than on the surface of the Earth. As can be seen, the atmosphere of Venus is sufficiently dense. In addition to carbon dioxide, the Venus atmosphere should contain also molecular nitrogen. The amount of this nitrogen, as can be assumed, is approximately the same as in the Earth's atmosphere.

Venus obviously rotates around its axis quite slowly. This was derived from observations of the thermal regime of the planet.

At a pressure of about 5 atm and a temperature of +300° C or more, it is almost certain that there are no seas on the surface of Venus.

How dark the world must be. Red-hot rocks, complete absence of water basins, a dense carbon dioxide atmosphere, and a heavy overcast which covers the entire sky. Through that overcast the Sun or stars cannot be seen at all. How different this picture appears from the colorful picture described in the poem which precedes this article.

The two sister planets Earth and Venus bear no resemblance at all. A great role in the fate of these sister planets was played by the varying distances from the Sun. From this example, we can see that closeness to the Sun is much more harmful for the development of life than a larger distance.

It is understood that the above described physical conditions of Venus are very primitive, and in the future our knowledge of these conditions will be improved as

time goes by. An important role in the improvement of our knowledge on the nature of Venus should be played by investigations with the help of automatic interplanetary stations. The first such station was successfully launched on February 12, 1961, in the direction of that planet (Fig. 3). We must be patient and wait for the valuable information about our cosmic neighbor, which will begin to arrive to us in May of this year. We should also keep in mind that one such flight will not solve all problems which are placed before science. The first flight will be followed by more such interplanetary stations. The scientific instruments will become more perfected. The time is not far away when Venus will not have any mysteries hidden from mankind.

THE PLANET OF MYSTERIES

by

A. Severnyi

Member Correspondent of the Academy of Sciences USSR
Director of the Crimean Astrophysical Observatory
per Izvestia, February 15, 1961

The interplanetary automatic station is traveling now at a distance of hundreds of thousands kilometers from the Earth in a space the nature of which we know very little.

All preceding flights into space of our satellites and rockets have made it possible to explain conditions in which the instruments aboard these satellites and rockets have to operate. Transmissions which were received from these flying stations testify to the fact that the instruments aboard these stations operate in a very satisfactory manner.

A gigantic trip of about 50 milliom km is in store for the interplanetary station headed toward Venus. Its flight will last about 100 days. Meteors, cosmic rays, and other particles with high energies will continue to bombard the body of the interplanetary station and its instruments during that period of time.

Of extreme scientific interest and practical value is the problem of the extent of radiation effects, particularly these effects which are connected with the activities of the Sun and the radiation caused by solar explosions.

It was discovered not so long ago that the occurrence of explosions on the Sun is accompanied in the majority of cases with a discharge of protons of high energies from 10 to 100 mev. On one hand this is a serious danger for live organisms, and on

the other hand these particles with high energies might have a strong effect on the results of measurements. For instance, a common photo plate designed for photographing the surface of the planet might prove to be hopelessly "over exposed" after a presence of several days in space even if it were well protected against light.

Investigations of radiation and many other effects during extended flights in space represent an important problem which is being encountered in the beginning of the era of interplanetary exploration.

As far as science is concerned, of great importance is also the investigation of the discharged solar corpuscular fluxes and the investigation of magnetic fields which these corpuscles carry with them.

Investigation of magnetic fields in interplanetary space is of great value for the explanation of the nature of corpuscular fluxes which originate on the Sun and the conditions of propagation of cosmic rays in our planetary system (Fig. 4). Very interesting data in this respect were obtained with the help of the second Soviet Lunik and the American cosmic rocket "Pioneer VI". These data indicated a fine structure of the magnetic field in interplanetary space and a simultaneous advance of magnetic disturbances on the rocket as well as on the Earth. It is possible that this has to do with a very rapid propagation of carriers of cosmic magnetic fields.

The planet Venus, toward which our cosmic laboratory is now speeding, is 1.5 times closer to the Sun than the Earth. The study of the movement of the guided interplanetary station will permit us to pinpoint more accurately not only the distance to that planet but also the value of the basic unit of distance in our solar system--the distance from the Earth to the Sun which is known as an astronomical unit. This is of utmost importance for future interplanetary exploration.

The dimensions of Venus are very close to the dimensions of the Earth. The surface of this planet is always hidden from us by a dense cloud cover. The structure and contents of the Venus atmosphere is in many respects still unknown to us. Its temperature varies from -50 to +300° C, although we do not know yet for sure to what in the Venus atmosphere these dimensions pertain. Spectroscopic investigations made by astronomers have so far enabled them to establish reliably the presence of a large quantity of carbon dioxide gas in the atmosphere of Venus. Not so long ago water vapors were found in that atmosphere. If oxygen is present there, it must be in very small quantities.

Obviously electrical discharges occur in the Venus atmosphere that are similar to our thunders but far more forceful. We have no definite knowledge in respect to the rotation of this planet; however, the majority of data points to the fact that this rotation is slow--considerably slower than the rotation of the Earth. We do not know at all how far the atmosphere of this planet extends. Does it have an ionosphere similar to our Earth, radiation belts as well as an extended corona similar to the Earth's geocorona?

It will be possible to obtain data on the structure and nature of the planets and their atmospheres only with the help of extremely precise and reliable instruments. Of no less importance is also the reliability of communications between the interplanetary station and the Earth at huge distances. The flight of the interplanetary station testifies to the fact that the gigantic difficulties on this road are being overcome by science and technology.

PRAVDA, February 19, 1961

TASS Communique

The flight of the Soviet automatic interplanetary station toward the planet Venus continues.

In accordance with the adopted program, a consecutive interrogation of the automatic interplanetary station took place on February 17 at 1404 Moscow time. At that time the automatic interplanetary station was located at a distance of 1,889,000 km from the surface of the Earth (above the Indian Ocean) at a point with the coordinates of 0° 39'S latitude and 54° 37'E longitude. The speed of departure of the interplanetary station from Earth was 3,923 meters/sec.

The interplanetary station still remains in a sector adjacent to the boundaries of the constellations of Pisces and Cetus, on a straight line between the stars β Cetus and α Andromeda. The right ascension of the automatic interplanetary station at that time was 0° 27'10"; the declination was -0. 38'50".

During the interrogation a great amount of radio telemetry information was obtained, measurements of the trajectory elements were conducted, and the velocity of the interplanetary station was determined.

Commands, which were given from the Earth, were received and carried out by the instruments aboard the station.

The processing of results of trajectory measurements have confirmed the fact that the interplanetary station continues its flight toward Venus along a trajectory which is close to the calculated. Preliminary data, which were obtained after the mathematical processing of measurements during the initial sector of the trajectory,

indicate that the automatic interplanetary station, after traveling along its orbit a distance of about 270 million km, will (without trajectory corrections) pass at a distance of more than 180,000 km from the center of the planet Venus. At that moment the automatic interplanetary station will be at a distance of about 70 million km from the Earth.

The instruments aboard the interplanetary station are functioning normally.

According to telemetry data, the temperature inside the station has been 28 to 30° C, and the pressure 900 mm Hg. The solar cells are operating reliably, and the charge of current of the chemical batteries is very satisfactory.

Results of measurements which were conducted with the help of the scientific instruments for the investigation of cosmic space are being processed now.

On February 19 at 1200 Moscow time, the interplanetary station will be at a distance of 2,537,000 km from the surface of the Earth.

RADIO MOSCOW (9.600 mc), 2015 PST, February 21, 1961

At 0600 Moscow time, February 21, 1961, the automatic interplanetary station reached a point 2,115,000 miles from the Earth's surface, still traveling over a trajectory which is very close to the calculated. It is now definite that the station will reach the vicinity of Venus in the second half of May. Our tracking stations at Irkutsk, Yakutsk and Mirnyi in the Arctic are making preparations for the interrogation of the automatic interplanetary station.

At Yakutsk a special institute and observatory was recently completed for the study of cosmic rays. This is the most advanced geophysical station of the Siberian Branch of the Soviet Academy of Sciences. The Yakutsk coordinates are 62° 30'N latitude and 128° E longitude.

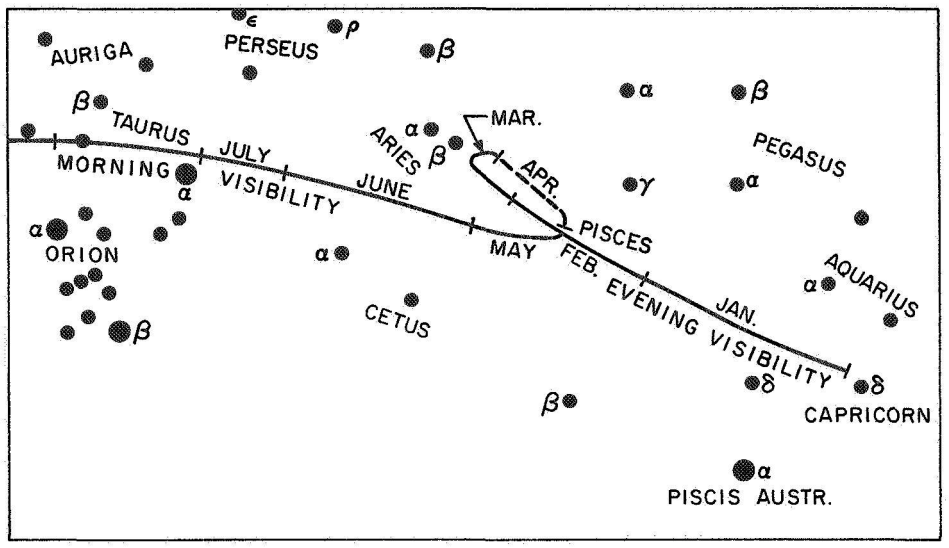

Fig. 1. Path of Venus across firmament

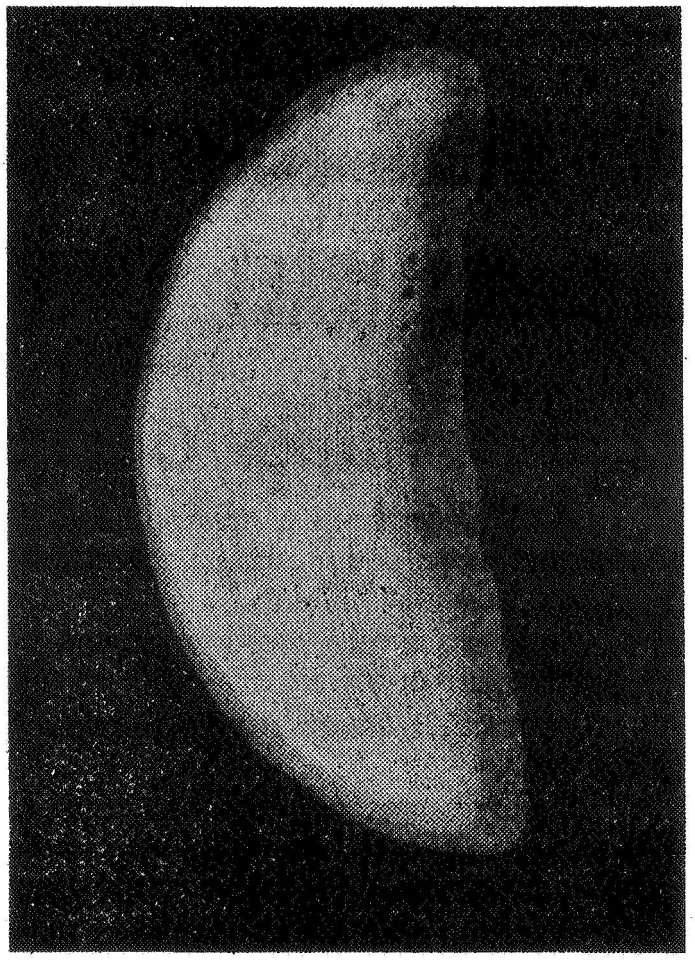

Fig. 2. Venus as photographed through 100 inch telescope

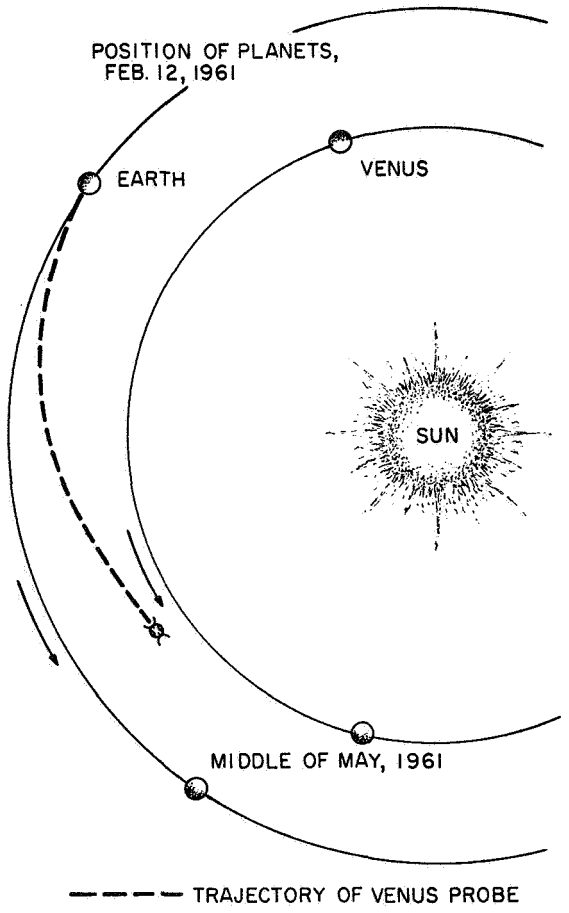

Fig. 3. Earth-Venus relationship during flight of interplanetary station

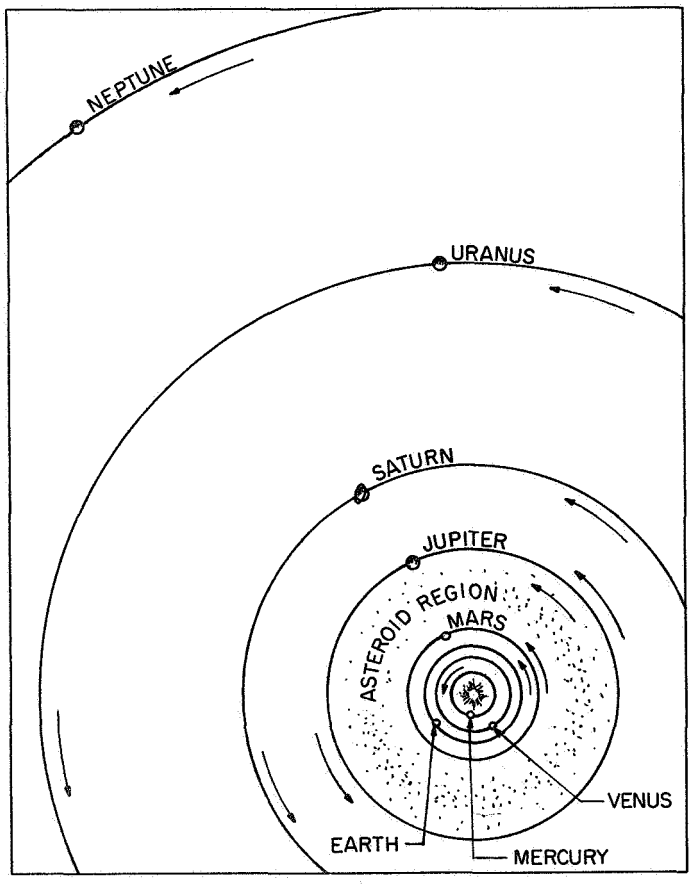

Fig. 4. Sector of solar system